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|---|--|---|--|---|--|
| FORM PTO-1390 (Modified)<br>(REV 11-98)   |  | U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE |  | ATTORNEY'S DOCKET NUMBER<br>112740-163                          |  |
| TRANSMITTAL LETTER TO THE UNITED STATES<br>DESIGNATED/ELECTED OFFICE (DO/EO/US)<br>CONCERNING A FILING UNDER 35 U.S.C. 371  |  |   |  | U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)<br><b>09/786701</b> |  |
| INTERNATIONAL APPLICATION NO.<br>PCT/DE99/02893   |  | INTERNATIONAL FILING DATE<br>10 September 1999          |  | PRIORITY DATE CLAIMED<br>10 September 1998                      |  |
| TITLE OF INVENTION<br><b>METHOD AND RADIO COMMUNICATION SYSTEM FOR PROVIDING A CONTROL CHANNEL</b>  |  |   |  |   |  |
| APPLICANT(S) FOR DO/EO/US<br><b>Michael Benz et al.</b>   |  |   |  |   |  |
| Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:   |  |   |  |   |  |
| <ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</li> <li>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c) (2)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ol> </li> <li>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</li> <li>7. <input checked="" type="checkbox"/> A copy of the International Search Report (PCT/ISA/210).</li> <li>8. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>9. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>10. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).</li> <li>11. <input checked="" type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409).</li> <li>12. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).</li> </ol> <p><b>Items 13 to 20 below concern document(s) or information included:</b></p> <ol style="list-style-type: none"> <li>13. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li>14. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li> <li>15. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.</li> <li>16. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</li> <li>17. <input type="checkbox"/> A substitute specification.</li> <li>18. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>19. <input checked="" type="checkbox"/> Certificate of Mailing by Express Mail</li> <li>20. <input checked="" type="checkbox"/> Other items or information:</li> </ol> |  |   |  |   |  |
| <p><b>Submission of Drawings - Figures 1-5 on five sheets</b></p>   |  |   |  |   |  |

|  |   |  |
|--|---|--|
| U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR<br><div style="font-size: 24pt; font-weight: bold;">09/786701</div> | INTERNATIONAL APPLICATION NO.<br>PCT/DE99/02893 | ATTORNEY'S DOCKET NUMBER<br>112740-163 |
|--|---|--|

|  |              |              |           |                              |    |
|--|--------------|--------------|-----------|------------------------------|----|
| 21. The following fees are submitted:..  |              |              |           | CALCULATIONS    PTO USE ONLY |    |
| <b>BASIC NATIONAL FEE ( 37 CFR 1.492 (a) (1) - (5) ) :</b>   |              |              |           |                              |    |
| <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO ..... |              |              |           | \$1,000.00                   |    |
| <input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO .....  |              |              |           | \$860.00                     |    |
| <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO .....  |              |              |           | \$710.00                     |    |
| <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) .....   |              |              |           | \$690.00                     |    |
| <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) .....   |              |              |           | \$100.00                     |    |
| <b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>  |              |              |           | \$860.00                     |    |
| Surcharge of \$130.00 for furnishing the oath or declaration later than _____ months from the earliest claimed priority date (37 CFR 1.492 (e)).   |              |              |           | \$0.00                       |    |
| CLAIMS   | NUMBER FILED | NUMBER EXTRA | RATE      |                              |    |
| Total claims   | 14 - 20 =    | 0            | x \$18.00 | \$0.00                       |    |
| Independent claims   | 2 - 3 =      | 0            | x         | \$0.00                       |    |
| Multiple Dependent Claims (check if applicable) .  |              |              |           | \$0.00                       |    |
| <b>TOTAL OF ABOVE CALCULATIONS =</b>   |              |              |           | \$860.00                     |    |
| Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable) .   |              |              |           | \$0.00                       |    |
| <b>SUBTOTAL =</b>  |              |              |           | \$860.00                     |    |
| Processing fee of \$130.00 for furnishing the English translation later than _____ months from the earliest claimed priority date (37 CFR 1.492 (f)).  |              |              |           | \$0.00                       |    |
| <b>TOTAL NATIONAL FEE =</b>  |              |              |           | \$860.00                     |    |
| Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).  |              |              |           | \$0.00                       |    |
| <b>TOTAL FEES ENCLOSED =</b>   |              |              |           | \$860.00                     |    |
|  |              |              |           | Amount to be: refunded       | \$ |
|  |              |              |           | charged                      | \$ |

- ☒ A check in the amount of **\$860.00** to cover the above fees is enclosed.
- ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \_\_\_\_\_ to cover the above fees.  
A duplicate copy of this sheet is enclosed.
- ☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

William E. Vaughan  
 Bell, Boyd & Lloyd LLC  
 P.O. Box 1135  
 Chicago, IL 60690-1135

SIGNATURE

William E. Vaughan

NAME

39,056

REGISTRATION NUMBER

March 8, 2001

DATE

BOX PCT

IN THE UNITED STATES ELECTED/DESIGNATED OFFICE  
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE  
UNDER THE PATENT COOPERATION TREATY-CHAPTER II

5

**PRELIMINARY AMENDMENT**

APPLICANTS: Michael Benz et al. DOCKET NO: 112740-163  
SERIAL NO: GROUP ART UNIT:  
EXAMINER:  
INTERNATIONAL APPLICATION NO: PCT/DE99/02893  
INTERNATIONAL FILING DATE: 10 September 1999  
INVENTION: METHOD AND RADIO COMMUNICATION SYSTEM FOR  
PROVIDING A CONTROL CHANNEL

15

Assistant Commissioner for Patents,  
Washington, D.C. 20231

Sir:

20

Please amend the above-identified International Application before entry  
into the National stage before the U.S. Patent and Trademark Office under 35 U.S.C.  
§371 as follows:

**In The Specification:**

On page 1, cancel lines 1-4 and substitute the following therefor:

25

**--SPECIFICATION****TITLE**

**METHOD AND RADIO COMMUNICATION SYSTEM FOR PROVIDING  
A CONTROL CHANNEL**

**BACKGROUND OF THE INVENTION**

30

**Field of the Invention--.**

On page 1, line 5, insert --present-- before "invention".

On page 1, line 5, cancel "a" before "radio".

On page 1, before line 9, insert the following left-hand justified heading:

**--Description of the Prior Art--**

On page 1, line 17, cancel "here".

On page 1, line 20, cancel the "," and substitute therefor a --;--.

On page 1, line 21, insert a --,-- after "example".

5 On page 1, line 24, cancel the "," and substitute therefor a --;--.

On page 2, line 5, cancel "can".

On page 2, line 5, insert --can-- after "also".

On page 2, line 10, cancel "global system for mobile" and substitute therefor  
--Global System for Mobile--.

10 On page 2, line 15, insert --present-- before "invention".

On page 2, lines 15-16, cancel "based on the object of specifying" and  
substitute therefor --, therefore, directed to--.

On page 2, line 16, cancel "a" before "radio".

On page 2, line 18, cancel "This".

15 On page 2, cancel lines 19-22.

On page 2, before line 23, insert the following centered heading:

**--SUMMARY OF THE INVENTION--**

On page 2, line 23, cancel "According" and substitute therefor --Thus,  
according--.

20 On page 2, line 23, insert --present-- before "invention".

On page 2, line 32, cancel "plurality" and substitute therefor --number--.

On page 2, line 38, cancel "plurality" and substitute therefor --number--.

On page 3, line 26, cancel the "," after "stations".

On page 3, line 32, cancel ", as" and substitute therefor --. As--.

25 On page 3, line 32, cancel "of which" and substitute therefor a --,--.

On page 3, line 36, cancel "by means of" and substitute therefor --via--.

On page 4, line 2, cancel "plurality" and substitute therefor --number--  
(occurs twice).

On page 4, line 9, insert a --,-- after "is".



- On page 6, line 18, cancel the “,” and substitute therefor a --;--.
- On page 6, line 18, insert a --,-- after “i.e.”.
- On page 6, line 19, insert a --,-- after “RNC”.
- On page 6, line 20, insert a --,-- after “turn”.
- 5 On page 6, line 24, insert --a-- after “contain”.
- On page 6, line 25, cancel “means” and substitute therefor --part--.
- On page 6, line 25, cancel “an” after “and”.
- On page 6, line 26, cancel “means” and substitute therefor --part--.
- On page 7, line 5, insert --present-- before “invention”.
- 10 On page 7, line 6, cancel the “,” and substitute therefor a --;--.
- On page 7, line 6, insert a --,-- after “particular”.
- On page 7, lines 8-9, cancel “time division duplex” and substitute therefor  
--Time Division Duplex--.
- On page 7, line 9, cancel “figure” and substitute therefor --Figure--.
- 15 On page 7, line 10, cancel “time division multiple access” and substitute  
therefor --Time Division Multiple Access--.
- On page 7, line 13, cancel “plurality” and substitute therefor --number--.
- On page 7, line 14, cancel the “,” and substitute therefor a --;--.
- On page 7, line 14, insert a --,-- after “example”.
- 20 On page 7, line 28, cancel “plurality” and substitute therefor --number--.
- On page 7, line 32, cancel “by means of” and substitute therefor --via--.
- On page 7, line 33, cancel “code division multiple access” and substitute  
therefor --Code Division Multiple Access--.
- On page 8, line 2, insert a --,-- after “and”.
- 25 On page 8, line 3, insert a --,-- after “thus”.
- On page 8, line 9, insert --preferred-- before “parameters”.
- On page 8, line 10, cancel “advantageously”.
- On page 8, line 20, cancel “frequency division duplex” and substitute  
therefor --Frequency Division Duplex--.

- On page 8, line 25, cancel “figure” and substitute therefor --Figure--.
- On page 9, line 13, insert --present-- before “invention”.
- On page 10, line 2, cancel “can” and substitute therefor a --,--.
- On page 10, line 2, insert a --,-- after “consequently”.
- 5 On page 10, line 2, insert --can-- after “easily”.
- On page 10, line 3, cancel “by means of” and substitute therefor --via--.
- On page 10, line 9, insert a --,-- after “particular”.
- On page 10, line 13, cancel “figure” and substitute therefor --Figure--.
- On page 10, line 18, insert a --,-- after “four”.
- 10 On page 10, line 18, cancel “can”.
- On page 10, line 18, insert --can-- after “also”.
- On page 10, line 32, insert a --,-- after “not”.
- On page 10, line 32, insert a --,-- after “therefore”.
- On page 10, line 35, cancel “figure” and substitute therefor --Figure--.
- 15 On page 10, line 37, cancel “by means of” and substitute therefor --via--.
- On page 10a, line 1, cancel “can”.
- On page 10a, line 2, insert --can-- after “also”.
- On page 11, line 13, cancel “can”.
- On page 11, line 13, insert --can-- after “also”.
- 20 On page 11, line 22, cancel “plurality” and substitute therefor --number--.
- On page 11, line 26, cancel “plurality” and substitute therefor --number--.
- On page 11, line 29, cancel “can”.
- On page 11, line 29, insert --can-- after “also”.
- On page 11, line 35, cancel “plurality” and substitute therefor --number--.
- 25 On page 12, line 7, cancel “plurality” and substitute therefor --number--.
- On page 12, line 13, cancel “by means of” and substitute therefor --via--.
- On page 12, line 21, insert --the-- before “synchronization”.
- On page 12, line 21, cancel “means” and substitute therefor --part--.
- On page 12, line 21, cancel “are” and substitute therefor --is--.

On page 12, line 27, cancel "means" and substitute therefor --part--.

On page 12, after line 29, insert the following paragraph:

--Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.--

After page 17, cancel line 1 and substitute the following centered heading therefor::

**--ABSTRACT OF THE DISCLOSURE--**

On page 17, line 3, cancel "According to the invention," and substitute therefor --A method and radio communication system for providing a control channel wherein--.

On page 17, line 12, cancel "plurality" and substitute therefor --number--.

On page 17, line 18, cancel "plurality" and substitute therefor --number--.

**In the Claims:**

On page 13, cancel line 1, and substitute the following left-hand justified heading therefor:

**--We Claim As Our Invention:--**

Please cancel claims 1-14, without prejudice, and substitute the following claims therefor:

15. A method for providing a control channel in a radio communication system, the method comprising the steps of:

assigning at least one channel which forms the control channel to a base station in order to transmit control information;

transmitting at least one synchronization sequence by the base station, the at least one channel corresponding to at least one of a selection of the at least one synchronization sequence and an order of a plurality of the synchronization sequences;



receiving, at a subscriber station, the at least one synchronization sequence;  
and

determining, via the subscriber station, a configuration of the control  
channel based on at least one of the recognized synchronization sequence which  
5 designates the at least one channel and the recognized order of the plurality of  
synchronization sequences.

16. A method for providing a control channel in a radio  
communication system as claimed in claim 15, wherein the configuration of the  
10 control channel relates to a variable number of the at least one channel, the at least  
one channel being designated by at least one of time slots, spread codes, and a  
combination of a scrambling code and a code designating the channel.

17. A method for providing a control channel in a radio  
15 communication system as claimed in claim 15, wherein the configuration of the  
control channel relates to a variable number of the at least one channel, the at least  
one channel being designated by a combination of a scrambling code and a code  
designating the channel.

18. A method for providing a control channel in a radio  
20 communication system as claimed in claim 15, wherein coding of the configuration  
of the control channel via at least one of the selection and the order of the  
synchronization sequences extends over a plurality of time slots.

19. A method for providing a control channel in a radio  
25 communication system as claimed in claim 15, wherein the synchronization  
sequences are transmitted in time slots in which the at least one channel is also  
arranged.

20. A method for providing a control channel in a radio communication system as claimed in claim 15, wherein the synchronization sequences are transmitted with less power than the control information.

5 21. A method for providing a control channel in a radio communication system as claimed in claim 15, wherein the synchronization sequences are unmodulated orthogonal gold codes.

10 22. A method for providing a control channel in a radio communication system as claimed in claim 15, wherein the synchronization sequences and control information are transmitted in time slots which are part of a TDD transmission system with broadband channels, with at least one time slot per frame being used for the synchronization.

15 23. A method for providing a control channel in a radio communication system as claimed in claim 15, wherein a plurality of base stations are synchronously assigned a time slot for transmitting the at least one synchronization sequence, adjacent base stations use a different time offset with respect to a start of the time slot for transmitting the synchronization sequence, and  
20 the time offset corresponds to at least one of a selection of the at least one synchronization sequence and the order of the plurality of synchronization sequences.

24. A method for providing a control channel in a radio communication system as claimed in claim 15, wherein two synchronization  
25 sequences are transmitted in one time slot.

25. A method for providing a control channel in a radio communication system as claimed in claim 24, wherein a time interval is predefined between the two synchronization sequences in the one time slot.

26. A method for providing a control channel in a radio communication system as claimed in claim 15, wherein further information is transmitted via the base station according to at least one of the selection and order of the synchronization sequences.

27. A method for providing a control channel in a radio communication system as claimed in claim 26, wherein the further information relates to at least one of spread codes, a scrambling code, a frame synchronization, and midambles used by the base station.

28. A radio communication system providing a control channel, comprising:

at least one base station for transmitting control information and at least one synchronization sequence;

a control device for assigning at least one channel which forms the control channel to the base station in order to transmit the control information, wherein the at least one channel corresponds to at least one of a selection of the at least one synchronization sequence and an order of a plurality of the synchronization sequences;

a subscriber station for receiving and evaluating the at least one synchronization sequence; and

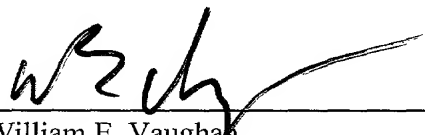
an evaluation part assigned to the subscriber station which determines a configuration of the control channel based on at least one of the recognized synchronization sequence which designates the at least one channel and the recognized order of the plurality of the synchronization sequences.

**REMARKS**

The present amendment makes editorial changes and corrects typographical errors in the specification in order to conform the specification to the requirements of the United States Patent practice. No new matter is added thereby. Original  
5 claims 1-14 have been canceled in favor of new claims 15-28. Claims 15-28 have been presented solely because the revisions by bracketing and underlining which would have been necessary in claims 1-14 in order to present those claims in accordance with preferred United States Patent practice would have been too extensive, and thus would have been too burdensome. The amendment is intended  
10 for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 U.S.C. §§101, 102, 103 or 112. Indeed, the cancellation of claims 1-14 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-14.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

  
\_\_\_\_\_  
(Reg. No. 39,056)  
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(312) 807-4292  
Attorneys for Applicants

JCOB Rec'd PCT/PTO 08 MAR 2001

## Description

Method and radio communication system for providing a control channel

5           The invention relates to a method and a radio communication system for providing a control channel, in particular within a mobile radio system with broadband channels and TDD or FDD transmission mode.

10           In radio communication systems, messages (for example voice, image information or other data) are transmitted over a radio interface using electromagnetic waves. The term radio interface refers to a connection between a base station and subscriber stations, it being possible for the subscriber stations  
15           to be mobile stations or fixed radio stations. The irradiation of the electromagnetic waves is carried out here with carrier frequencies lying in the frequency band provided for the respective system. Frequencies in  
20           the frequency band of approximately 2000 MHz are provided for future radio communication systems, for example the UMTS (Universal Mobile Telecommunication System) or other 3rd generation systems.

25           Two modes are provided for the third generation mobile phone system, one mode designating an FDD mode (frequency division duplex), see ETSI STC SMG2 UMTS-L1, Tdoc SMG2 UMTS-L1 221/98, dated 25.8.1998 and the other mode designating a TDD mode (time division duplex), see DE 198 27 700. The modes of operation are applied in different frequency bands and both use time slots.

30           In ETSI STC SMG2 UMTS-L1, Tdoc SMG2 UMTS-L1 221/98, dated 25.8.1998, a synchronization method which uses synchronization sequences which are transmitted in each time slot is described in chapters 2.3.3.2.3 and 6.3 for the FDD mode. This thus makes it possible to  
35           synchronize the subscriber

stations with the start of the time slot. The order of the transmissions of a second synchronization sequence signals which code group (scrambling code) is being used by the base station. Furthermore, the frame start  
5 can also be derived therefrom.

A method for providing a control channel, according to which a channel is established in a predefined frequency band for transmitting the control information, is known from the GSM mobile radio system  
10 (global system for mobile communications). Only a limited amount of control information, which is sufficient in the GSM mobile radio system for signaling to the voice services, can be transmitted over this one channel.

15 The invention is based on the object of specifying a method and a radio communication system with which a greater degree of flexibility can be achieved in the provision of a control channel. This object is achieved by means of the method having the  
20 features of claim 1 and the radio communication system having the features of claim 14. Further developments can be found in the subclaims.

According to the invention, one or more channels which form the control channel are assigned to  
25 a base station in order to transmit control information. This makes it possible to vary the data rate of the control channel. At least one synchronization sequence is transmitted by the base station, the channel or channels of the control channel  
30 corresponding to the selection of one or more synchronization sequences and/or to the order of a plurality of synchronization sequences. A subscriber station receives the at least one synchronization sequence and determines the configuration of the  
35 control channel on the basis of the recognized synchronization sequence which designates the channel or channels and/or on the basis of the recognized order of a plurality of synchronization sequences.

In order to signal the configuration of the control channel, it is possible, for example, to use a large number of variants of a single synchronization sequence and/or the order of the transmission of  
5 different synchronization sequences. In this way, an indication of a scalable control channel is possible even in the synchronization phase and with little additional expenditure.

The control channel can be adapted to the  
10 individual requirements of the individual radio cells and also over time in accordance with the services offered. The flexibility of the provision of control information over the control channel is thus significantly greater.

15 The configuration of the control channel in the TDD mode is advantageously designated by the number, the time slots used within a frame structure and/or the spread codes used for the channels. In the FDD mode, this is a combination of scrambling code and code which  
20 designates the channel (channelization code). This information may be complete in itself or may relate to parameters which are previously known on a system-wide basis. In accordance with the instantaneous requirements of a radio cell, the capacity of the  
25 control channel is adapted in a way which can be traced by the subscriber stations, in that, for example, additional spread codes in an already assigned time slot and/or additional time slots with a spread code are assigned as channels within the control channel and  
30 the assignment is signaled using the synchronization sequences. When the required capacity is reduced, the assignment is cancelled, as a result of which the capacity is expanded with the channels which have become free for the transmission of user data.

35 A high coding gain is achieved if the coding of the configuration of the control channel by means of the selection

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As in the FDD mode described above, two synchronization sequences are advantageously



transmitted in one time slot. The first synchronization sequence is used to determine the reception time and the coarse synchronization. The order of the second synchronization sequences over a plurality of transmissions encodes the control channel and possible other information such as a time offset of the transmission within the time slot. According to one advantageous development of the invention, a time interval is predefined between the two synchronization sequences in one time slot. This provides the possibility of using a single, switchable filter for detecting both synchronization sequences. The second synchronization sequence can also be transmitted before the first so that the time interval is negative. Further information can be encoded with the time ratio of the first synchronization sequence to the second synchronization sequence. If two different filters are used, the two sequences can also be transmitted simultaneously. If there are two chronologically separated synchronization sequences, the disruptive interference is better distributed over time so that less burst-like interference occurs.

It is also advantageous to transmit further information by means of a selection of the synchronization sequences and/or their order. This permits more rapid readiness to operate of the subscriber stations. The further information relates to a frame synchronization and midambles and spread codes used by the base station in the TDD mode, or the code group (scrambling code) used by the base station in the FDD mode.

Exemplary embodiments of the invention are explained in more detail with reference to the appended drawings, in which:

Figure 1 shows a radio communication system,

Figure 2 shows a schematic representation of a TDD radio interface between the base station and subscriber stations,

Figure 3 shows an arrangement for transmitting  
5 synchronization sequences,

Figure 4 shows control channels which are configured in different ways, and

Figure 5 shows a flowchart representing the synchronization and the determination of the  
10 configuration of the control channel.

The mobile radio system illustrated in figure 1 as an example of a radio communication system is composed of a plurality of mobile switching centers MSC which are interconnected to one another and which form  
15 the access to a fixed network PSTN. Furthermore, these mobile switching centers MSC are connected to, in each case, at least one device RNC for controlling the base station BS and for distributing radio resources, i.e. a radio resource manager. Each of these devices RNC in  
20 turn permits connection to at least one base station BS. Such a base station BS can set up a connection to a subscriber station, for example mobile stations MS or other mobile and fixed terminals, over a radio interface. The subscriber stations MS contain  
25 synchronization means SYNC for synchronizing, and evaluation means AUS for detecting and evaluating the signals received by the base station BS. At least one radio cell is formed by each base station BS.

Figure 1 shows, by way of example, connections  
30 V1, V2, V3 for transmitting user information and signaling information between mobile stations MS and a base station BS, and a control channel BCCH as a point-to-multipoint connection. Control information oi which can be evaluated by all the subscriber stations MS and  
35 data relating to the services offered in the radio cell and relating to the configuration of the channels of the radio interface are contained in the control channel BCCH.

An operations and maintenance center OMC performs monitoring and maintenance functions for the mobile radio system or for part thereof. The functionality of this structure can be transferred to  
5 other radio communication systems in which the invention can be used, in particular for subscriber access networks with wireless subscriber connection.

The frame structure of a TDD (time division duplex) radio transmission can be seen in figure 2.  
10 According to a TDMA (time division multiple access) component, there is provision for a broadband frequency range, for example the bandwidth  $B = 5$  MHz, to be split up into a plurality of time slots  $ts$  of the same duration, for example 16 time slots  $ts_0$  to  $ts_{15}$ . A  
15 frequency band extends over a frequency range  $B$ . Some of the time slots are used in the downlink direction DL, and some of the time slots are used in the uplink direction UL. By way of example, an asymmetrical ratio of 3:1 in favor of the downlink direction DL is shown.

In this TDD transmission method, the frequency  
20 band for the uplink direction UL corresponds to the frequency band for the downlink direction DL. The same is repeated for further carrier frequencies. The variable assignment of the time slots  $ts$  for the uplink  
25 direction or downlink direction UL, DL enables various asymmetrical resource assignments to be performed.

Within the time slots  $ts$ , information on a plurality of connections is transmitted in radio blocks. The data  $d$  is spread on a connection-specific  
30 basis with a fine structure, a spread code  $c$ , so that at the receive end it is possible, for example, to separate  $n$  connections by means of this CDMA component (code division multiple access). The spreading of individual symbols of data  $d$  has the effect that  $Q$   
35 chips of the duration  $T_{\text{chip}}$  are transmitted within the symbol duration  $T_{\text{sym}}$ . The  $Q$  chips form the connection-specific spread code  $c$  here.

One channel K1, K2, K3, K4 is designated within a frequency band B by a timeslot ts, a spread code c and thus implicitly a spread factor. The dimension of the time slot ts is not present in the FDD mode.

5           Within a broadband frequency range B, the successive time slots ts are divided up in a frame structure. 16 time slots ts are thus combined to form a frame fr.

10           The parameters used for the radio interface are advantageously:

chiprate:                           4.096 Mcps

frame length:                       10 ms

number of time slots:               16

length of a time slot:              625  $\mu$ s

15   spread factor:                   16

type of modulation:                 QPSK

bandwidth:                          5 MHz

frequency repetition value: 1

20           These parameters permit the best possible harmonization with an FDD mode (frequency division duplex) for the 3rd generation mobile phone system. Signaling to the control channel BCCH can be carried out using the synchronization sequences described below, not only in TDD mode but also in FDD mode.

25           In the downlink direction according to figure 3, two time slots ts0, ts8, for example, are used for synchronization. Thus, in one time slot ts8, in each case two synchronization sequences cp, cs are transmitted separated by a time interval tgap. The  
30   separation of the two synchronization sequences cp, cs has the advantage of reduced interference because the noise power of the two sequences is distributed better over time. The first synchronization sequence cp is the same in each time slot ts0, ts8. The second  
35   synchronization sequence cs

can be newly selected from time slot ts0 to time slot ts8.

The selection and order of the second synchronization sequence cs corresponds to a time offset toff with which the transmission of the first synchronization sequence cp is delayed with respect to the start of the time slot ts8. As a result of the reception and evaluation of the synchronization sequences cs, the receiving subscriber station MS can determine the time offset toff and take it into account in the synchronization.

Adjacent base stations BS are frame-synchronized in TDD mode. According to the invention, adjacent base stations BS are assigned a different time offset toff for the transmission of the synchronization sequences. For example, 32 different time offsets toff are used so that cell groupings (clusters) can be formed, and if the time offset toff changes for a base station BS it is not necessary to change the entire grouping.

As a result of the selection and order of the second synchronization sequences cs over, for example, 4 frames fr and two time slots ts0, ts8 per frame fr, when 17 different unmodulated orthogonal gold codes with 256 chip length are used,  $17^8$  different possibilities with which further information can be transmitted in addition to the time offset toff are obtained. As a result of the large number of possibilities, the coding gain is large so that the synchronization sequences cp, cs can be transmitted with little power.

The further information relates to the frame synchronization, midambles used by the base station, spread codes (midambles and spread codes being allocated independently of one another) and data relating to the configuration of a control channel

BCCH. When two time slots  $ts$  per frame  $fr$  are used for synchronization, the frame start after the synchronization is recognized in a time slot  $ts$

[illegible]

is still imprecise with the factor two. The frame synchronization can consequently easily be brought about by means of a specific order of second synchronization sequences  $cs$ . Furthermore, the later  
5 detection of information of the control channel BCCH is speeded up if midambles, spread codes and data relating to the configuration are already transmitted during the synchronization.

In particular the possibility arises of  
10 introducing a scalable control channel BCCH which is indicated by the order of the synchronization sequences  $cs$  irrespective of the use of the time offset  $toff$ . According to figure 4, it is possible, for example, to transmit control information in one, two or four  
15 channels. As a result of the signaling with the synchronization sequences  $cp$ ,  $cs$ , any desired channels  $K1$ ,  $K2$ ,  $K3$ ,  $K4$  designated by spread codes  $c$  and time slots  $ts$ , even above the number four can also be signals. In transmission methods without a TDMA  
20 component or without a CDMA component, the data relating to the time slots  $ts$  and the spread codes  $c$  becomes superfluous. Other parameters relating to the channels  $K1$ ,  $K2$ ,  $K3$ ,  $K4$  of the control channel BCCH may possibly have to be signaled depending on the  
25 transmission method selected.

In this way, the data rate of the control channel BCCH can be matched to the cell-specific requirements in accordance with the services offered there. Future modifications of the control channel BCCH  
30 are thus made possible. The parameters (number of channels, time slots and spread codes) of the control channel BCCH do not therefore need to be defined in advance on a system-wide basis but rather can be signaled during the synchronization.

35 In addition to the variants in figure 4, it is also possible to indicate additional channels with control information by means of the further information

from the synchronization. Thus, control information can also be transmitted temporarily in additional channels. The control channel

for the control channel



BCCH becomes parallel to other user data connections, but is transmitted with greater error protection coding, if appropriate.

The transmissions of the control channel BCCH  
5 and of the synchronization sequences  $c_p$ ,  $c_s$  are preferably located in the same time slot  $t_s$ , as a result of which only two time slots  $t_{s0}$ ,  $t_{s8}$  have to be continuously reserved for the downlink direction DL. The adjustability of the asymmetry is limited only to a  
10 small degree.

If the asymmetry ratios in the system are such that more than two time slots  $t_{s0}$ ,  $t_{s8}$  are used for the downlink direction DL, control information can also be transmitted in the remaining timeslots  $t_s$  assigned to  
15 the downlink direction DL. It is then also possible to transmit the control information exclusively in time slots  $t_s$  in which the synchronization sequences  $c_p$ ,  $c_s$  are not transmitted. In this way, the interference on the user data connections is reduced further. The  
20 flexibility of the control channel BCCH provides additional advantages because, for example, distribution among a plurality of time slots brings about a greater degree of immunity of the transmission to interference.

25 The use of a multicode transmission in the control channel BCCH (a plurality of spread codes  $c$  per time slot  $t_s$ ) within a time slot  $t_s$  permits the data rate of the control channel BCCH to be increased adaptively. A similar effect can also be achieved by  
30 reducing the spread factor, which is also indicated by the selection and order of the synchronization sequences  $c_s$ . The selection of the time slots  $t_s$  for transmitting the control information can be coordinated by a superordinate entity, for example a radio resource  
35 manager, RNC, for a plurality of base stations BS.

The assignment, performed in a control device, for example the radio resource manager RNC of a base station system,

of time slots  $ts_0$ ,  $ts_8$  for the synchronization of channels  $K_1$ ,  $K_2$ ,  $K_3$ ,  $K_4$  of the control channel and of different time offsets  $t_{off}$  with respect to the start of the time slot  $ts_0$ ,  $ts_8$  for the transmission of the synchronization sequences  $cp$ ,  $cs$  precedes the synchronization as the first step 1. In a second step 2, a plurality of base stations BS transmit the synchronization sequences  $cp$ ,  $cs$  in the predefined order, which is specific for each base station BS and corresponds to the time offset  $t_{off}$ .

A subscriber station MS receives the synchronization sequences  $c_p$ ,  $c_s$  in a third step 3 and carries out a coarse synchronization by means of the first synchronization sequence  $c_p$ . As a result of the evaluation of the second synchronization sequences  $c_s$  in a fourth step 4, the synchronization of the time slot to the start of the time slot  $t_s$  is possible, after which, by evaluating the further information, the frame synchronization is also carried out in a fifth step 5. The steps 3 to 5 are carried out by synchronization means SYNC which are assigned to the subscriber station and which constitute, for example, a signal processor and correlators formed by signal-matched filters.

25           In a sixth step 6, the configuration of the control channel BCCH is determined in the evaluation means AUS formed by a signal processor, using the further information, and the preparation of the reception of the control channel BCCH is initiated.

## Patent Claims

1. A method for providing a control channel (BCCH) in a radio communication system, in which one or more  
5 channels (K1, K2, K3, K4) which form the control channel (BCCH) are assigned to a base station (BS) in order to transmit control information (oi),  
at least one synchronization sequence (cp, cs) is transmitted by the base station (BS), the channel or  
10 channels (K1, K2, K3, K4) corresponding to the selection of one or more synchronization sequences (cp, cs) and/or to the order of a plurality of synchronization sequences (cp, cs),  
a subscriber station (MS) which receives at least one  
15 synchronization sequence (cp, cs),  
the subscriber station (MS) determines the configuration of the control channel (BCCH) on the basis of the recognized synchronization sequence (cp, cs) which designates the channel or channels (K1, K2,  
20 K3, K4), and/or on the basis of the recognized order of a plurality of synchronization sequences (cp, cs).
2. The method as claimed in claim 1, in which the configuration of the control channel (BCCH) relates to a variable number of channels (K1, K2, K3, K4) which  
25 are designated by time slots (ts) and/or spread codes (c) or a combination of scrambling code and code designating the channel.
3. The method as claimed in claim 1, in which the configuration of the control channel (BCCH) relates to  
30 a variable number of channels (K1, K2, K3, K4) which are designated by a combination of scrambling code and code designating the channel.
4. The method as claimed in one of the preceding claims, in which

coding of the configuration of the control channel (BCCH) by means of the selection and/or order of the synchronization sequences (cp, cs) extends over a plurality of time slots (ts).

5 5. The method as claimed in one of the preceding claims, in which the synchronization sequences (cp, cs) are transmitted in time slots (ts) in which the channels (K1, K2, K3, K4) of the control channel (BCCH) are also arranged.

10 6. The method as claimed in one of the preceding claims, in which the synchronization sequences (cp, cs) are transmitted with less power than the control information (oi).

7. The method as claimed in one of the preceding  
15 claims, in which the synchronization sequences (cp, cs) are unmodulated orthogonal gold codes.

8. The method as claimed in one of the preceding claims, in which the synchronization sequences (cp, cs) and control information are transmitted in time slots  
20 (ts) which are part of a TDD transmission arrangement with broadband channels, one or more time slots (ts) per frame (fr) being used for the synchronization.

9. The method as claimed in one of the preceding claims, in which a plurality of base stations (BS) is  
25 synchronously assigned a time slot (ts) for transmitting the at least one synchronization sequence (cp, cs),

adjacent base stations (BS) using a different time offset (toff) with respect to the start of the time  
30 slot (ts) for transmitting the synchronization sequence (cp, cs), and

the time offset (toff) corresponds to the selection of one or more synchronization sequences (cp, cs) and/or the order of a plurality of synchronization sequences  
35 (cp, cs).

10. The method as claimed in one of the preceding claims, in which two synchronization sequences (cp, cs) are transmitted in one time slot (ts).

11. The method as claimed in claim 10, in which a  
5 time interval (tgap) is predefined between the two synchronization sequences (cp, cs) in one time slot (ts).

12. The method as claimed in one of the preceding claims, in which further information is transmitted by  
10 the base station (BS) by means of a selection of synchronization sequences (cp, cs) and/or their order.

13. The method as claimed in claim 12, in which the further information relates to a frame synchronization and/or midambles used by the base station (BS) and/or  
15 spread codes (c) and/or a scrambling code.

14. A radio communication system providing a control channel (BCCH),  
having at least one base station (BS) for transmitting control information (oi) and at least one  
20 synchronization sequence (cp, cs),  
having a control device (RNC) which assigns one or more channels (K1, K2, K3, K4) which form the control channel (BCCH) to the base station (BS) in order to transmit the control information (oi), the channel or  
25 channels (K1, K2, K3, K4) corresponding to the selection of one or more synchronization sequences (cp, cs) and/or the order of a plurality of synchronization sequences (cp, cs),  
having a subscriber station (MS) for receiving and  
30 evaluating the at least one synchronization sequence (cp, cs),  
having evaluation means (AUS) which are assigned to the subscriber station and which determine the configuration of the control channel (BCCH) on the  
35 basis of the recognized synchronization sequence (cp, cs) which designates the channel or channels (K1, K2, K3, K4) and/or

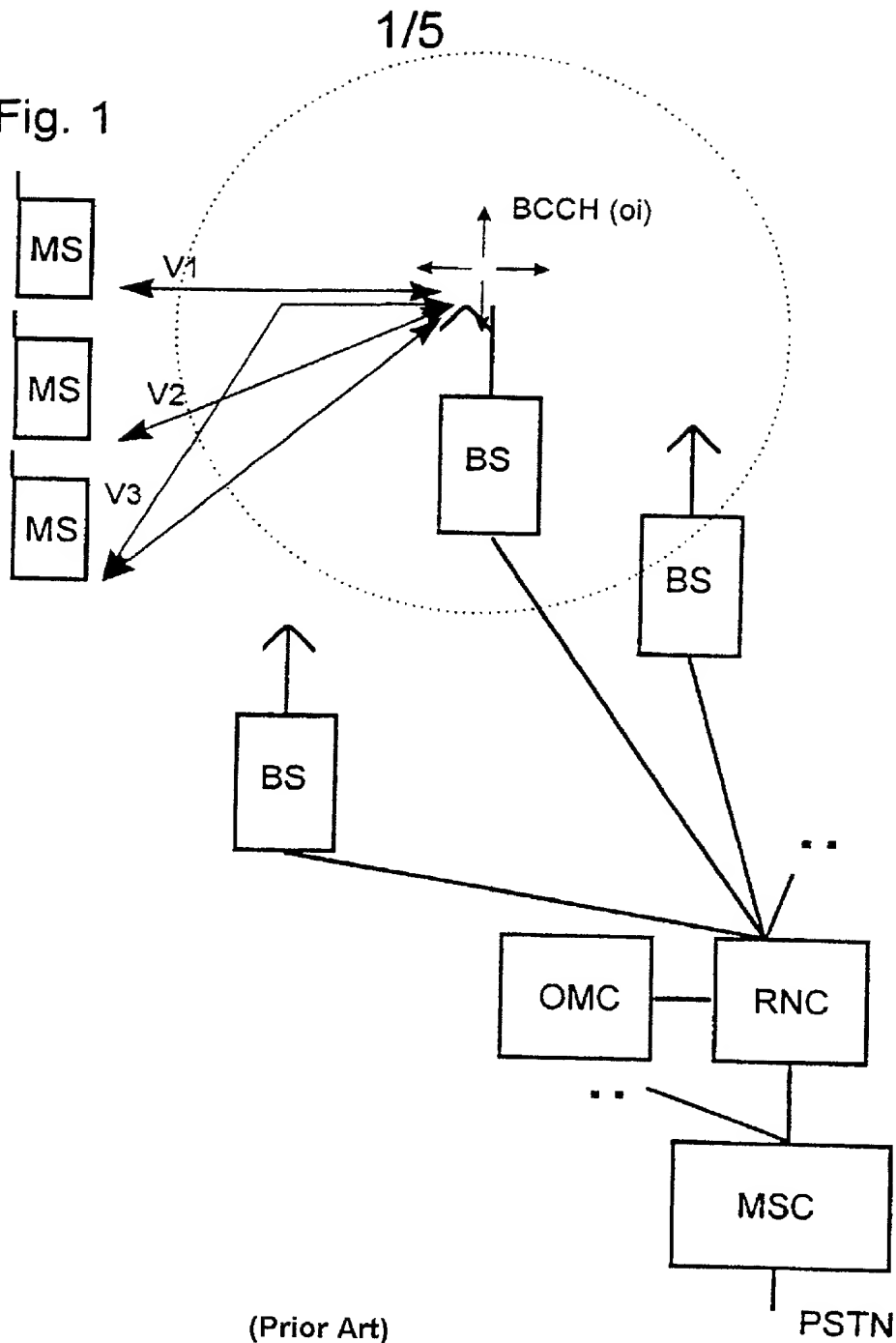
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the recognized order of a plurality of synchronization sequences (cp, cs).

Publ. No. 1999/02893



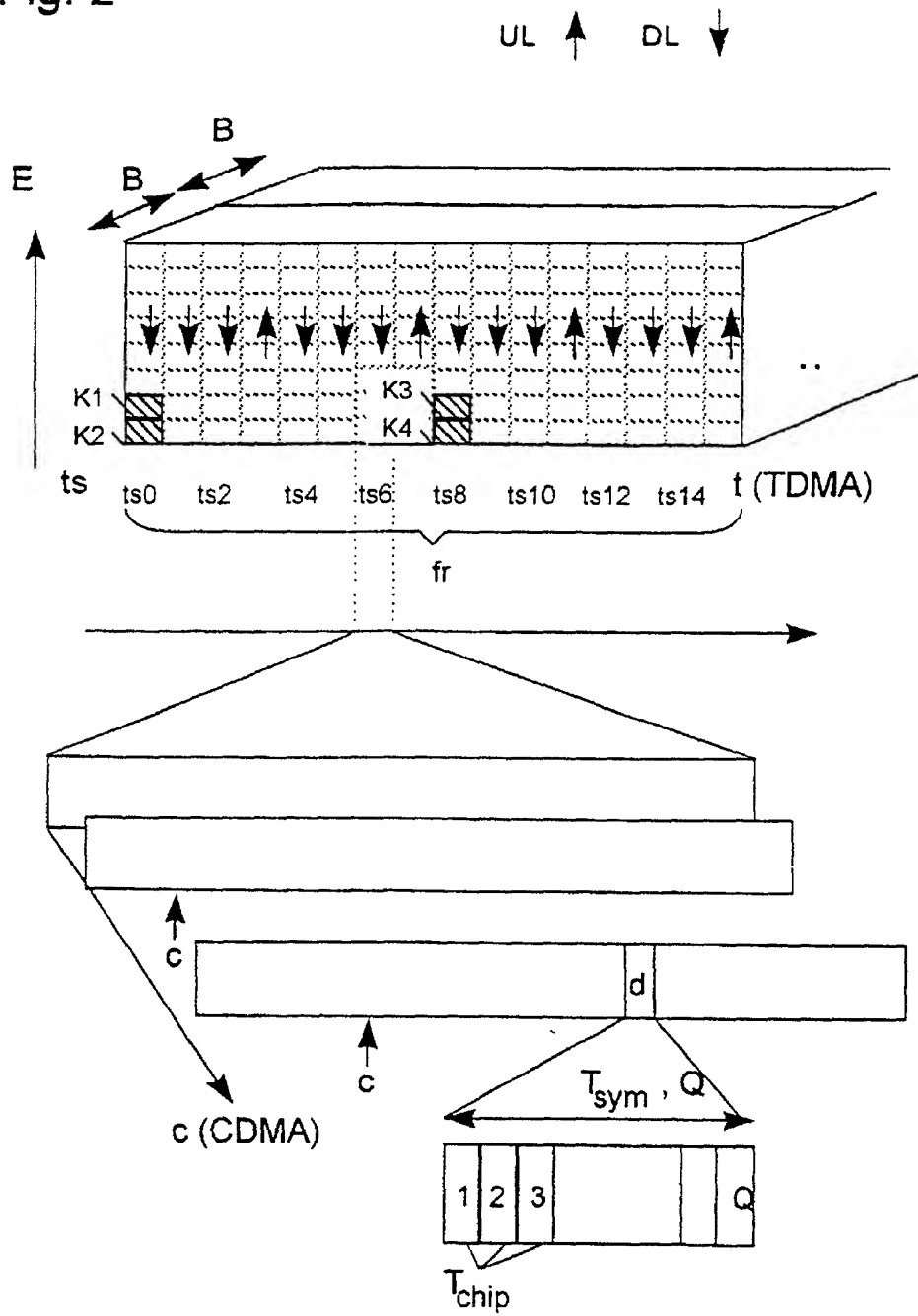
Fig. 1





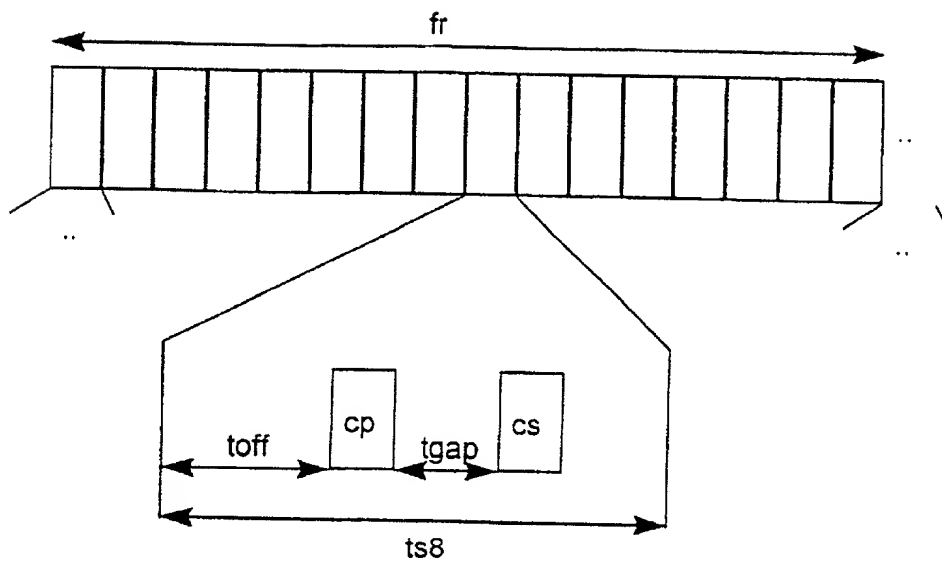
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Fig. 2




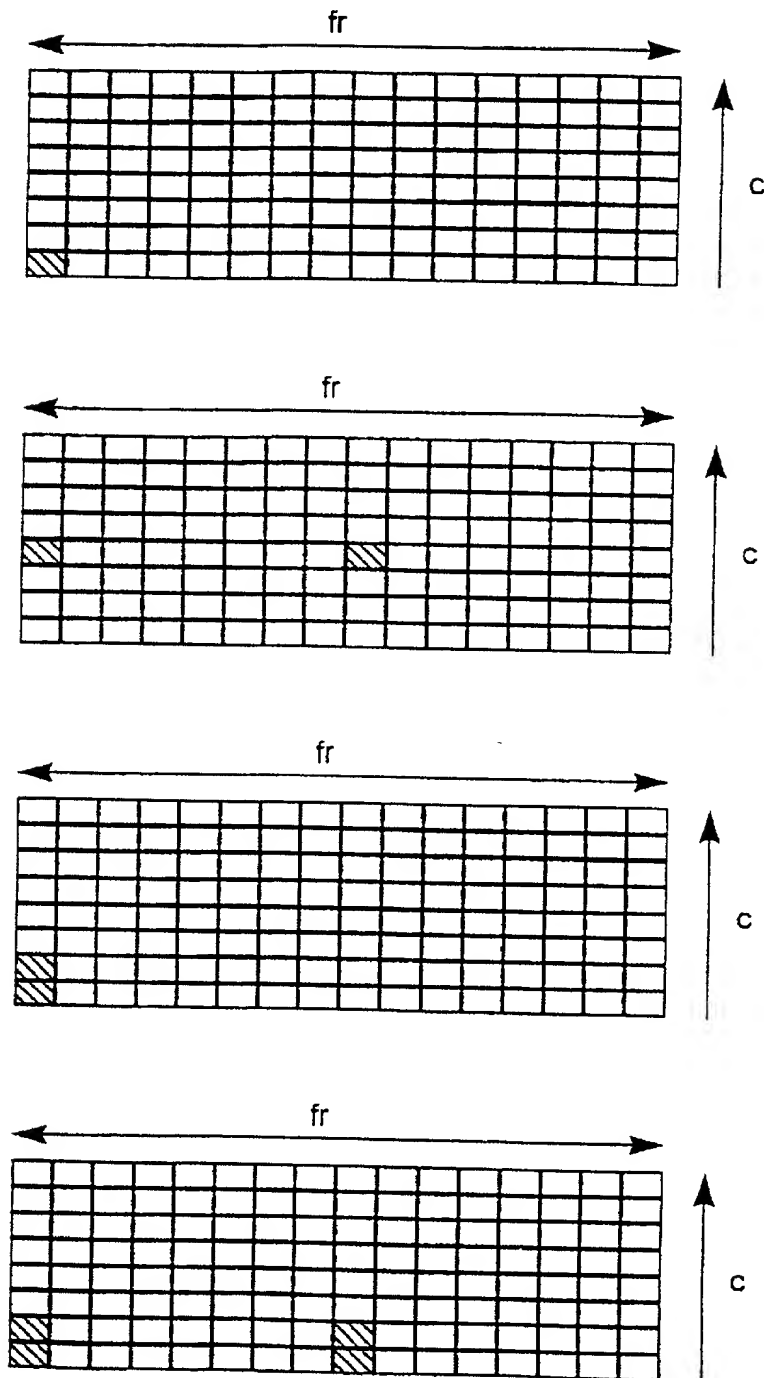
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Fig. 3



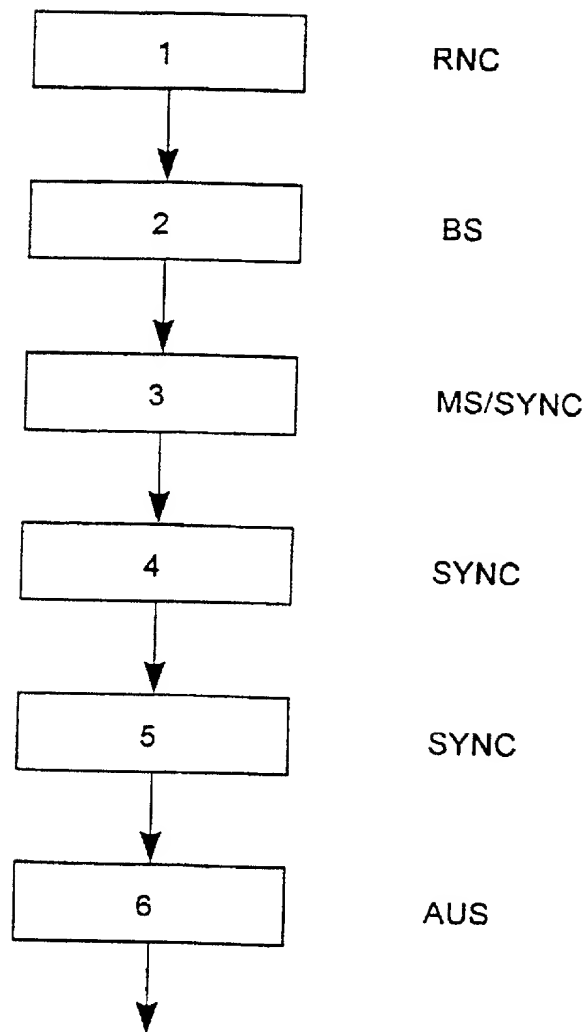
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Fig. 4

 BCCH

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Fig. 5



### German Language Declaration

Patent and Trademark Office-U.S. DEPARTMENT OF COMMERCE

## German Language Declaration

Prior foreign applications  
Priorität beansprucht

Priority Claimed

198 41 464.1 Germany 10. September 1998  
(Number) (Country) (Day Month Year Filed)  
(Nummer) (Land) (Tag Monat Jahr eingereicht)

☒ ☐  
Yes No  
Ja Nein

\_\_\_\_\_  
(Number) (Country) (Day Month Year Filed)  
(Nummer) (Land) (Tag Monat Jahr eingereicht)

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Yes No  
Ja Nein

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(Number) (Country) (Day Month Year Filed)  
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Yes No  
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Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

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(patented, pending,  
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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

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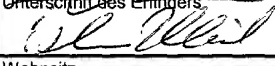
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| Unterschrift des Erfinders:<br> | Datum<br><b>7 Feb 2001</b> | Inventor's signature                        | Date |
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| Staatsangehörigkeit<br><b>Bundesrepublik Deutschland</b>   |                            | Citizenship                                 |      |
| Postanschrift<br><b>Sandhauser Str. 109 B</b>  |                            | Post Office Address                         |      |
| <b>D-13505 Berlin</b>  |                            |   |      |
| <b>Bundesrepublik Deutschland</b>  |                            |   |      |
| Voller Name des vierten Miterfinders (falls zutreffend):   |                            | Full name of fourth joint inventor, if any: |      |
| Unterschrift des Erfinders   | Datum                      | Inventor's signature                        | Date |
| Wohnsitz   |                            | Residence                                   |      |
| Staatsangehörigkeit  |                            | Citizenship                                 |      |
| Postanschrift  |                            | Post Office Address                         |      |
|  |                            |   |      |
| Voller Name des fünften Miterfinders (falls zutreffend):   |                            | Full name of fifth joint inventor, if any:  |      |
| Unterschrift des Erfinders   | Datum                      | Inventor's signature                        | Date |
| Wohnsitz   |                            | Residence                                   |      |
| Staatsangehörigkeit  |                            | Citizenship                                 |      |
| Postanschrift  |                            | Post Office Address                         |      |
|  |                            |   |      |
| Voller Name des sechsten Miterfinders (falls zutreffend):  |                            | Full name of sixth joint inventor, if any:  |      |
| Unterschrift des Erfinders   | Datum                      | Inventor's signature                        | Date |
| Wohnsitz   |                            | Residence                                   |      |
| Staatsangehörigkeit  |                            | Citizenship                                 |      |
| Postanschrift  |                            | Post Office Address                         |      |
|  |                            |   |      |